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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

GARBER, CHARLES D

ART UNIT PAPER NUMBER

2856

DATE MAILED: 06/20/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/917,363

Applicant(s)

JOHNSTON, MATTHEW M.

Examiner

Charles Garber

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 May 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 9-19 and 21-28 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 9-11, 14, 16-19, 21, 22, 25, 27 and 28 is/are rejected.
- 7) ☒ Claim(s) 12, 13, 15, 23, 24 and 26 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 July 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

The Applicant has canceled claims 1-8 and 20 drawn to a separate invention.

Claim Rejections - 35 USC § 112

Claim 17 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter that was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 17 includes the step of holding the probe at a constant separation during measurement, which will also maintain the probe at a constant van der Waal or Casimir force level; the process then repeats this operation for a plurality of points. However, the claim then includes the step of comparing forces at the plural points to determine a defect. This is not possible as all the forces will be the same. For purposes of further examination Examiner will assume the device is continuing in a constant height mode but is comparing probe movement (required to maintain the constant height above the surface) to determine a defect.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 9-11, 14, 17, 18, 21, 22, 25 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Martin et al. (US Patent 5,283,442) in view of Takahashi et al. (US Patent 6,537,648).

Regarding claim 9, Martin discloses a method and apparatus for surface profiling using an atomic force microscope (AFM) which is equivalent to determining the degree to which the shape of a first surface varies from a nominal shape. Martin discloses the holding the probe and moving the probe so as to maintain a constant tunneling current or constant deflection which maintains a constant force and hence a constant distance from the surface (column 4 lines 3-21) The Martin reference further incorporates by reference US Patent 4,724,318 which discloses the probe is initially brought into a position "to within a preselected distance, i.e., about 0.3 nm". Bringing the probe tip to within a preselected distance then moving the probe tip so as to maintain the same force is considered equivalent to holding the first surface (probe tip) a known separation distance from a second surface (measured surface). Martin and the incorporated reference show probe tips that are either flat or sharp and are thus having a known shape.

Martin however discloses using measured deflections in terms of voltages or tunnel current rather than measured force values to compare/determine changes from the initial or nominal value required to control the probe tip at a constant distance. However, as the voltages or currents are proportional to force values and because Applicant has not disclosed that the force values is used for any purpose other than to control the second (probe) surface Examiner considers the reference voltage values to be substantively equivalent to force values. Examiner in fact considers the equating of probe deflection or tunneling current measured values to force value to be standard practice in the art of atomic force microscopy.

Further, Martin does not disclose the force is a result of Casimir forces. However, Examiner considers the forces acting on the Martin probe and the effects being sensed to inherently be the result of Casimir forces. Edwards et al. in US Patent 6,094,971 explains that an AFM scanning tip within a distance of tens of nanometers may interact with the scanned surface by the action of Casimir forces (column 7 lines 54-64). As the probe tip of Martin is acting within this distance the tip is considered to be inherently reacting to Casimir forces.

Finally, Martin does not expressly disclose the measured surface is an electrically conductive surface.

Takahashi teaches a method of producing a substrate for an information recording medium (e.g. a magnetic disk) including measuring surface variation in terms of flatness, waviness, microwaviness and finally roughness. (title, background and figure 1) The magnetic disk is equivalent to a first electrically conductive surface and

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roughness is shown measured from a nominal wavy surface as illustrated at the bottom of figure 1 using an atomic force microscope (AFM).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to scan a conductive magnetic surface of a disk in order to determine its roughness and ensure that only disks with minimum roughness are used in order to reduce glide height and permit greater recording density.

As for claim 10, as discussed above Takahashi teaches the measured surface is a surface of a disc (disk) employed in a disc (disk) drive. It would have been obvious to one having ordinary skill in the art at the time the invention was made to scan a conductive magnetic surface of a disk in a disk drive to the same reasons given above.

As for claim 11, Martin discloses the first or probe 10 has a flat surface (see figures 1, 2 and 4B) parallel to the x-y plane of travel. Takahashi teaches the second or measured disk surface is nominally flat which is an advantageous feature in drive disks as discussed above and will be disposed substantially parallel to the AFM probe surface. Martin however does not expressly measure "attractive" Casimir forces between the first and second surfaces as in the instant invention.

Examiner considers that when the probe is moved close to the sample surface in an AFM device, a van der Waals or Casimir attractive force inherently acts between an atom at the tip of the probe and an atom on the sample surface. Only if the atoms move close to each other so as to nearly contact, do repulsive forces occur therebetween due to the Pauli exclusion principle. These principles are widely known in the art of AFM and Examiner takes Official Notice that it is widely known to operate

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AFM devices in either or both attractive and repulsive modes. It would have been obvious to one having ordinary skill in the art at the time the invention was made to operate an AFM device in attractive or repulsive modes balancing benefits of higher resolution from close contact with faster scanning and less risk of damaging the surface with further scanning distances.

As for claim 14, Takahashi further teaches determining average as well as maximum waviness, microwaviness or roughness as measured by AFM contactless laser interference techniques and further ensuring the maximum microwaviness amount is less than a threshold defined as the height of a head slider or reproducing head (column 2 line 22 to column 5 line 67 particularly column 5 lines 64-67). This requirement implies that maximum values less than the head are pass and that maximum values greater than the head height fail. It would have been obvious to one having ordinary skill in the art at the time the invention was made to ensure only disks with surface variations less than a threshold amount should pass so the disk will not interfere with and damage a disk drive read head in a finished drive device.

As for claim 17, as discussed above Takahashi advantageously taught testing a magnetic disk surface with an atomic force measuring device - a magnetic disk in a disk drive is a rotating disk. In doing so, Takahashi teaches measuring the surface profile which are measurements at a plurality of locations. Takahashi further teaches the maximum microwaviness (discussed above as a criteria for pass/fail) is the 95 percentile value of all the microwaviness values. This value is determined by extracting the 95 percentile point from a histogram of all microwaviness values. Examiner

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considers inherent in this process comparing each microwaviness value to each other microwaviness value in order to derive the appropriately ordered histogram.

Regarding claim 18, the references as discussed above with respect to claim 9 disclosed or suggested a method and apparatus for determining the degree to which the shape of a first electrically conductive surface varies from a nominal shape and including an electrically conductive test surface (disk of Takahashi) having a known shape (nominally flat) and a force gauge (probe 10 and cantilever 12 of Martin) that measures the force exerted between the first surface and the test surface to obtain a measured exerted force value. Martin also discloses a computer 32 which is a processor which performs the functions of the instant invention as discussed above with respect to claim 9 above. Though the references do not expressly include a grasping member that holds the first surface (probe) a known distance from the test surface all atomic force microscope devices inherently include some sort of supporting member to hold the cantilever and probe at a given distance from the sample surface, therefore a grasping member is considered to be inherent in the references.

Claim 21 is substantively the same as claim 10 as discussed above.

Claim 22 is substantively the same as claim 11 as discussed above.

Claim 25 is substantively the same as claim 14 as discussed above.

Claim 28 is substantively the same as claim 17 as discussed above.

Claims 16, 19, 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Martin et al. (US Patent 5,283,442) as modified by Takahashi et al. (US Patent

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6,537,648) and applied to claim 9 above and further in view of Edwards et al. (US Patent 6,094,971).

Regarding claim 16, as shown in the figures Martin discloses probe 10 which is a first object with a first surface on the bottom of the probe (which is a side of the probe) and substrate 20 which is a second object with a second surface on the top of the substrate (which is a side of the substrate). However Martin discloses measuring displacement (which is equivalent to force as discussed above) using a laser interferometer 24 rather than a piezoelectric transducer affixed to one of the object sides as in the instant invention.

Edwards teaches using a quartz tuning fork 2 (which is a piezoelectric device) coupled to a side of a probe tip 6 to measure Casimir force effects in a scanning probe microscope (see figure 2A and column 6 lines 15-26, column 7 lines 32-64).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to use a piezoelectric device to detect normal tip-sample interactions as a preferred alternative to optical means when samples are light sensitive (title and column 2 lines 1-27).

Claims 19 and 27 are substantively the same as claims 16 and 18 as discussed above.

Allowable Subject Matter

Claims 12, 13, 15, 23, 24, 26 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 12, the prior art teaches all the limitations except for using the specific physical relationship between force and distance of the instant invention in an AFM profiler.

Regarding claim 13, the prior art teaches all the limitation except for the first surface is a substantially spherical surface while the second surface is a substantially flat surface. The Mohideen et al. reference provided by the Applicant teaches using a spherical surface in an AFM device, but not the purpose of enhancing the measurement tool. The Mohideen reference was using an AFM device to scientifically verify the specific effect of Casimir forces with no particular practical application expressly provided.

As for claim 15, the references discussed above lack further including steps (d) and (e), performed prior to step (c), of:

(d) if the first and second surfaces are not in contact with each other, moving the first surface closer to the second surface, to a new known separation distance; and

(e) repeating measuring step (b) and moving step (d) until the first and second surfaces are in contact with each other; wherein comparing step (c) comprises comparing the last exerted force value measured prior to the first and second surfaces contacting each other to a nominal force value that would be expected to be exerted between the first

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and second surfaces as a result of the Casimir force if the shape of the first surface were equivalent to the nominal shape.

Besocke et al. (US Patent 5,325,010) teaches moving in a stepwise Z direction as in the instant invention but does not include the step of comparing last exerted force value measured prior to contacting the measured surface to a nominal force.

Tong (US Patent 5,847,383) teaches "the operation for causing the probe of the cantilever of the scanning probe microscope to approach the sample can be performed such that the output signal from the probe displacement signal detection section is differentiated, and change in the result of the differentiating operation is used to quickly stop the coarse adjustment mechanism after the probe has been brought into contact with the surface of the sample." However, this is a continuous operation and the instant invention is a stepwise operation.

Claims 23, 24 and 26 are allowable for substantially the same reasons as claims 12, 13 and 15 respectively.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The additional references cited on the accompanying form PTO-892 though not cited above are provided to indicate other prior art Atomic Force Profiler or disk measurement methods and apparatus which include one or more features or limitations in common with the instant invention.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Charles Garber whose telephone number is (703) 308-6062. The examiner can normally be reached on 6:30 a.m. to 3:00 p.m..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hezron Williams can be reached on (703) 305-4705. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7725 for regular communications and (703) 308-7725 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-4900.



cdg
June 13, 2003